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READINESS AND RETENTION: PILOT FLIGHT EXPERIENCE AND AIRCRAFT MISHAPS (UNCLASSIFIED)

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Budget constraints which yield reductions in flight hours per pilot imply an eventual shifting of the distribution of flight hours.

Analyses show that the rate of pilot error mishaps tends to decrease as pilots' flight experience increase. These data suggest, therefore, that as the experience levels of naval aviators decline, the mishap rate will increase. The experience levels of Training Command/ Fleet Readiness Squadron instructor pilots would also tend to decrease, thereby contributing both directly and indirectly to an increased mishap rate. The total effect will, of course, also depend upon aggregate flight hour reductions as well as pilot retention rates.

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READINESS AND RETENTION:

PILOT FLIGHT EXPERIENCE

AND

AIRCRAFT MISHAPS

DR. MICHAEL S. BOROWSKY

U.S. NAVAL SAFETY CENTER

STATISTICS AND MATHEMATICS DEPARTMENT

June 24, 1986

ABSTRACT

Budget constraints which yield reductions in flight hours per pilot imply an eventual shifting of the distribution of flight hours.

Analyses show that the rate of pilot error mishaps tends to decrease as pilots' flight experience increase. These data suggest, therefore, that as the experience levels of naval aviators decline, the mishap rate will increase. The experience levels of Training Command/Fleet Readiness Squadron instructor pilots would also tend to decrease, thereby contributing both directly and indirectly to an increased mishap rate. The total effect will, of course, also depend upon aggregate flight hour reductions as well as pilot retention rates.

INTRODUCTION

Pilot error mishaps in Naval Aviation during the calendar years 1977-1985 cost $1.7 billion- not including "indirect" items such as survivors' benefits, litigation, and full aircraft replacement costs. In addition, there were 400 fatalities, including 173 pilots in these mishaps.

Analyses of aircraft mishaps, pilot flight experience, and exposure data showed that in general, more experienced aviators had a lower probability of pilot error mishaps than those aviators with little flight experience. In particular, pilots with extensive experience--both in model and total hours--had a low pilot error mishap rate, while inexperienced pilots in the fleet readiness squadrons and during the initial half of their first tour had a particularly high rate.

These results imply a strong relationship between aviation safety and flight experience, and therefore, readiness and retention. Higher retention rates likely imply an increased distribution of flight hours for experienced aviators and, therefore, lower mishap rates and increased operational readiness--if mission and flight tempo parameters are not modified.

Previous studies (References 1-3) have shown the existence of relationships between pilot error mishaps and the experience levels of the pilots. Updated results are provided in this analysis.

The high risk levels for pilots were:

	Hours in Model/Total Hours
Fighter:	300- / 750-
Attack:	300- / 450-1500
Single-seat TACAIR:	300- / 450-750
Multi-seat TACAIR:	300- / 750-
Helo:	300- / 450-750

(e.g., fighter pilots with 300- hours in model and simultaneously 750-total hours had a high pilot error mishap rate. On the other hand, pilots with extensive experience--both in model and total hours--had a low pilot error mishap rate.)

Analysis pertaining to the Training Command (4) showed that the pilot error mishap rate for instructor pilots (while flying with students) significantly decreased as hours flown in training aircraft increased. The rates were particularly high for instructors with less than 300 hours in trainers--regardless of whether these new instructors were "SERGRADS" or fleet experienced aviators.

The effects of certain variables were not quantified. Therefore, absence or presence of specific statistical relationships may be partially the result of command attention such as increased safety emphasis by commanders during high tempo periods, special scheduling for pilots with minimal experience in model, and mission profile differences as a function of flight experience.

SUMMARY RESULTS

Fighter

FRS: The rate was extremely high*.

First tour-initial portion: The rate was extremely high*.

Transition/SERGRAD: The rate was low--relative to pilots with 750- total hours* and relative to pilots with more extensive hours in model.

Attack

FRS: The rate was low relative to pilots in the initial portion of their first tour and was high relative to pilots with more extensive hours in model.

First tour-initial portion: The rate was extremely high*.

Transition/SERGRAD: The rate did not differ substantially from the FRS but was low relative to pilots in the initial portion of their first tour and high* relative to pilots with more extensive hours in model.

Single seat TACAIR

FRS: The rate was low* relative to pilots in the initial portion of their first tour but did not differ substantially from pilots with more extensive experience.

First tour-initial portion: The rate was extremely high*.

Transition/SERGRAD: The rate did not differ substantially from the and from pilots with more extensive hours in model but was low* relative to pilots in the initial portion of their first tour.

Multi-seat TACAIR

FRS: The rate was extremely high.

First tour-initial portion: The rate was low relative to pilots in the FRS but was high relative to pilots with more extensive experience.

Transition/SERGRAD: The rate was low relative to pilots in the FRS through the initial portion of their first tour but--if total hours were 1500- --was high relative to pilots with more extensive hours in model. The rate--if total hours were 1500+--did not differ substantially from pilots with more extensive hours in model.

Helicopter

FRS: The rate was low relative to pilots with 451-1000 total hours but did not differ substantially from pilots who had 1000+ total hours.

First tour-initial portion: The rate was extremely high*

Transition/SERGRAD: The rate was low relative to pilots in the initial portion of their first tour but was high relative to FRS pilots and pilots with more extensive hours in model.

*Denotes statistically significant result at <.05.

Definitions: FRS: 300- hours in model and 450- total hours.

First tour-initial portion: 300- hours in model and 451-750 total hours.

Transition/SERGRAD: 300- hours in model and 750+ total hours.

Notation: "-" by itself denotes "less than", e.g., 300- means less than 300.

DETAILED RESULTS

Fighter:

The pilot factor mishap rate was significantly (α=.005) related to total hours (Table I). Pilots with 450- hours had the highest rate followed by those who had 451-750 hours. The mishap rate was not significantly (α=.218) related to hours in model in themselves. Pilots with 300- hours in model had the highest rate, while those with 1000+ hours had the lowest rate, however. Interactions showed an extremely high rate for pilots who had 300- hours in model and simultaneously 750- total hours. In fact, for pilots with 300- hours in model, the rate significantly (α=.012) decreased as total hours increased. There was no statistical evidence, however, that maximizing hours in model relative to total hours yielded reduced mishap rates. For each total hour category, the mishap rate was not significantly associated with hours in model (α=.229, .646, .327 for the 451-750, 751-1500, and 1500+ total hour categories, respectively). Though the rate decreased as hours in model increased for pilots who had 451-750 total hours, this was not the case for pilots in the 750+ total hour categories.

Attack:

The pilot factor mishap rate significantly decreased as total hours (α=.035) and hours in model increased (α<.001) (Table II). Interactions showed an extremely high rate for pilots who had 300- hours in model and simultaneously 451-1500 total hours. In fact, for pilots with 300- hours in model, the rate increased as total hours increased from 450- to 451-750, but then decreased as total hours increased beyond 750. This relationship was not statistically significant, however (α=.130). In addition, career patterns which maximized hours in model relative to total hours yielded lower pilot factor mishap rates than patterns for which hours in model were severely limited. Specifically, for each total hour level, the rate for pilots who had 300- hours in model (e.g., SERGRAD, transition pilots) was higher than the rates for pilots who had 301-500, 501-1000, or 1000+ hours in model. These associations between mishap rate and hours in model, in fact, were significant for pilots who had 451-750 or 751-1500 total hours (α =.004, .008, respectively) but was not significant for pilots who had 1500+ total hours (α=.191).

Single seat TACAIR:

The pilot factor mishap rate was significantly related to total hours (α=.010) and hours in model (α <.001) (Table III). The rate decreased as hours in model increased and, with respect to total hours, was highest at the 451-750 level. Interactions showed an extremely high rate for pilots who had 300- hours in model and simultaneously 451-750 total hours. Furthermore, for pilots with 300- hours in model, the rate increased as total hours increased from 450- to 451-750 and then decreased as total hours increased beyond 750. This association was statistically significant (α =.002). The rate (for pilots with 451-750 total hours) significantly decreased (α<.001) as hours in model increased to 300+. There was no significant evidence, however, that maximizing hours in model relative to total hours yielded reduced mishap rates for pilots with 750+ total hours (α=.120, .287 for rate vs. hours in model for pilots who had 751-1500 and 1500+ total hours, respectively).

Multi-seat TACAIR:

The pilot factor mishap rate was significantly associated with total hours (α =.006) and hours in model (α=.008) (Table IV). The rate decreased as hours in model increased and, with respect to total hours, was highest for pilots with 750- --particularly if 450-. Interactions showed that for pilots with 300- hours in model, the rate decreased as total hours increased. In addition, for pilots with 1500- total hours, career patterns which maximized hours in model relative to total hours yielded reduced mishap rates. This, however, was not the case for pilots who had 1500+ total hours. The results for these interactions were not statistically significant, however. (α =.176 for rate vs. total hours for pilots with 300- hours in model, α =.554, .209, .131 for rate vs. hours in model for pilots with 451-750, 751-1500, 1500+ total hours, respectively)

Helicopters:

The pilot factor mishap rate was significantly (α =.004) related to total hours (Table V). Pilots with 451-750 total hours had the highest rate, while those with 2000+ had the lowest rate. The mishap rate was not significantly (α=.647) related to hours in model in themselves. Pilots with 1000+ hours in model had the lowest rate, however. Interactions showed that pilots with 451-750 total hours who also had 300- hours in model possessed an extremely high rate. For pilots with 300- hours in model, the rate was significantly (α=.003) related to total hours--increasing as total hours increased from 450- to 451-750 and decreasing as total hours increased further. Moreover, pilots who had 2000+ total hours and also 1000+ hours in model possessed a very low rate. Career patterns which maximized hours in model relative to total hours generally yielded lower pilot factor mishap rates than patterns for which hours in model were severely limited (e.g., SERGRAD, transition pilots). Specifically, for <u>each</u> total hour level, the rate for pilots who had 300- hours in model was higher than the rate for pilots who had 500+ hours in model. These relationships were significant, however, only for the 451-750 total hour level (α=.011); for the 751-1000, 1001-2000, 2000+ levels, α =.617, .447, .210, respectively).

References

1. "Fighter Aircraft Class A F/FRM Rates vs. Pilot Experience CY 77-83," APPROACH Magazine, January 1985

2. "Attack Aircraft Class A F/FRM Rates vs. Pilot Experience CY 77-83," APPROACH Magazine, November 1984

3. "Helicopter Class A F/FRM Rates vs. Pilot Experience CY 77-83," APPROACH Magazine, March 1985

4. "Naval Training Command Mishaps and Instructor Experience," Aviat., Space Environ. Med. 57: 65-70, 1986 (Jan), by M. S. Borowsky, Ph.D.

TABLE I - FIGHTER

HOURS IN MODEL

TOTAL HOURS	300-	301-500	501-1000	1000+	Total
450-	17 9.99	—	--	—	17 9.99
451-750	10 9.62	5 4.41	--	--	15 6.75.
751-1500	4 3.94	3 4.20	11 4.07	0 0.00	18 3.72
1500+	4 2.27	5 5.04	14 5.78	12 3.65	35 4.14
Total	35 6.35	13 4.54	25 4.82	12 3.26	85 4.95

The figures denote class A flight/flight-related pilot error mishaps and rate per 100,000 flight hours.

TABLE II - ATTACK

HOURS IN MODEL

TOTAL HOURS	300-	301-500	501-1000	1000+	Total
450-	15 5.62	--	--	--	15 5.62
451-750	17 10.73	6 2.72	--	--	23 5.46
751-1500	8 7.32	6 5.71	9 1.70	3 3.75	26 3.15
1500+	9 4.60	4 3.10	17 4.18	22 2.33	52 3.10
Total	49 6.09	16 3.44	26 2.71	25 2.45	116 3.58

The figures denote class A flight/flight-related pilot error mishaps and rate per 100,000 flight hours.

TABLE III - SINGLE-SEAT TACAIR

HOURS IN MODEL

TOTAL HOURS	300-	301-500	501-1000	1000+	Total
450-	8 4.36	—	—	—	8 4.36
451-750	17 15.68	3 2.27	—	—	20 7.77
751-1500	5 5.86	3 4.25	6 1.81	3 6.65	17 3.19
1500+	7 4.72	3 3.49	12 4.69	14 2.40	36 3.36
Total	37 7.04	9 3.02	18 2.98	17 2.71	81 3.94

The figures denote class A flight/flight-related pilot error mishaps and rate per 100,000 flight hours.

TABLE IV - MULTI-SEAT TACAIR

HOURS IN MODEL

TOTAL HOURS	300-	301-500	501-1000	1000+	Total
450-	22 8.14	—	--	—	22 8.14
451-750	10 6.17	8 4.18	--	—	18 4.97
751-1500	6 5.75	5 5.05	14 3.18	0 .00	25 3.53
1500+	5 2.85	6 4.71	19 5.29	15 2.50	45 3.57
Total	43 6.04	19 4.50	33 4.08	15 2.26	110 4.22

The figures denote class A flight/flight-related pilot error mishaps and rate per 100,000 flight hours.

TABLE V - HELICOPTERS

HOURS IN MODEL

TOTAL HOURS	300-	301-500	501-1000	1000+	Total
450-	14 2.16	0 .00	--	--	14 2.04
451-750	14 8.30	14 2.82	5 4.30	--	33 4.23
751-1000	3 5.06	2 6.24	16 3.39	--	21 3.73
1001-2000	6 2.78	2 1.35	12 1.93	19 3.13	39 2.45
2000+	5 2.73	3 2.86	7 2.48	9 1.11	24 1.74
Total	42 2.34	21 2.57	40 2.68	28 1.98	131 2.38

The figures denote class A flight/flight-related pilot error misahps and rate per 100,000 flight hours.